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The Vegetative Organs of Some Perennial Grasses

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THE VEGETATIVE ORGANS OF SOME PERENNIAL GRASSES.

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INDEX

Frequently occasions arise when it is expedient to identify grasses from other than their flower or fruit characterizations. There have been many botanical descriptions of grasses written, but these have been for the most part descriptive, or of hay crops, or briefly given as from the standpoint of distribution. John Percival, in his text book on "Agricultural Botany"[1] gives brief attention to the sheath, ligule and rhizome.

Many grasses change in appearance from the spring to autumn form, others are never allowed to blossom. M'Alpine: "Grasses,"[2] gives a method whereby the grasses may be identified by leaf characteristics. Work by Hackel, "The True Grasses;"[3] Beal, "Grasses of North America"[4]; L. H. Pammel, Carlton R. Ball, and F. Lamson-Scribner, "Grasses of Iowa"[5]; in general give the keys based on botanical descriptive characters, other than the vegetative organs, together with their habitat and economic value.

Hitchcock has taken up the morphology of the vegetative organs of some of the grasses in his "Text Book of Grasses"[6]. Hitchcock and Chase have included descriptions of vegetative organs in their work on the species of Panicum, in "Contributions from the United States National Herbarium"[7]. Reference is made to the rhizomes and morphology by Pammel, Weems,

[1]Percival, John, Agricultural Botany.
[2]M'Alpine, A. N., Grasses.
[3]Hackel, Eduard, The True Grasses.
[4]Beal, W. J., Grasses of North America, I.
[5]Pammel, L. H., Ball, Carlton R., Lamson-Scribner, F., Grasses of Iowa, Part II. Iowa Geological Survey. 1903.
[6]Hitchcock, A. S., A Text Book of Grasses, f. 95-111.
[7]Hitchcock, A. S., and Chase, Agnes. The North American Species of Panicum. Contributions from the United States National Herbarium, Vol. 15.

Lamson-Scribner in "Grasses of Iowa."[8] Here may also be mentioned the work done by Clark and Malte on the "Fodder and Pasture Plants of Canada"[9], which included in some instances bud and rhizome characters. Hitchcock and Clothier, in a Kansas Experiment Station Bulletin on "Vegetative Propagation of Perennial Weeds"[10] have described the habits of growth of the rhizomes of various weeds including a few grasses. Another study of rhizomes is that of Pammel and Fogel on "The Underground Organs of a Few Weeds."[11] In this was included a description of *Agropyron repens.*

Lyman Carrier, in a U. S. Department of Agriculture Bulletin, has written a very comprehensive report on the "Identification of Grasses by Their Vegetative Characters."[12] He has given the bud characters, leaf, ligule and auricle, but he has not included a study of the rhizomes of perennials. In this study, the work of Carrier is followed, including in some cases different species and a study of the characters of the rhizomes of perennials only.

METHOD OF PROCEDURE.

The rhizomes of twenty-seven perennial grasses were gathered and planted in the greenhouse in fertile soil, the latter part of October. Duplicates of these were placed in the laboratory in sphagnum moss. Temperature readings were kept and development of new buds from the rhizomes was noted, also whether or not any of these grasses had a resting period.

The rhizomes in both instances were kept under uniform conditions as to moisture and temperature. The temperatures in the greenhouse ranged from 65° to 70° F., while those in the laboratory were much lower, ranging from 38° to 70° F. The rhizomes grown in the sphagnum were submitted to conditions undesirable for their best growth, such as lack of moisture, too much moisture, and lack of suitable lighting conditions. However, under these conditions *Agropyron repens, Poa compressa,* and *Dactylis glomerata,* put forth vigorous

[8]Pammel, L. H., Weems, J. B., Lamson-Scribner, F., The Grasses of Iowa: Iowa Geological Survey Bull. 1, 1901.
[9]Clark, Geo. H., Malte, M. Oscar, Fodder and Pasture Plants in Dominion of Canada: Department of Agriculture, Dominion of Canada, 1913.
[10]Hitchcock, A. S., and Clothier, Geo. L., Fifth Report on Kansas Weeds—Vegetative Propagation of Pesennial Weeds: Bull. Kan. Ag. Exp. Sta. 76, 1898.
[11]Pammel, L. H., and Fogel, Estella D., The Underground Organs of a Few Weeds. Proc. Iowa Acad. Sci., Vol. XVI, p. 36. 1909.
[12]Carrier, Lyman, The Identification of Grasses by Their Vegetative Characters. U. S. Dept. Agric. Bull. 461, 1917.

growths more conspicuously than any of the others. *Bromus inermis, Elymus robustus, Koeleria cristata,* and *Phleum pratense* failed to grow either in the laboratory or in the greenhouse. This might have been due to any number of possible causes, the most probable of which was failure to obtain a vigorous rhizome for planting. All of the figures were drawn from specimens of the greenhouse grasses, so that they are representative of uniform conditions.

Many of the grasses had resting periods. Striking illustrations of those having rest periods, are, *Muhlenbergia Mexicana, Muhlenbergia racemosa, Spartina cynosuroides, Stipa spartea.* The two species of Muhlenbergia had resting periods of four months, while the resting periods of the others were two months. All of the other grasses began to grow within three weeks, but none of them grew vigorously until March.

DEFINITION OF TERMS USED IN THIS DISCUSSION.

The use of the term "grasses" is restricted to those plants classed as Graminea. The Carex is used here as a means of contrast. The grasses may be distinguished from sedges by the following characters: stems jointed, unusually hollow, leaves in two ranks, alternate, the leaves consisting of the blade, sheath, ligule and collar. The blade is narrow and elongated; sheath, tubular in structure, usually enclosing the stem; the ligule, a membranous appendage at the base of the blade. The rhizome or rootstock consists of a thickened underground stem, by which the grass may perpetuate its growth and from which arise the true roots. Thus the perennial grass plant may be said to consist of root, rhizome, culm, leaf and flower. A perennial grass may be distinguished from an annual by the presence of the rhizome. It is frequently difficult to distinguish the rhizome of a perennial. But instead of a creeping rhizome as in the *Agropyron repens* there is developed a thickened basal portion from which buds arise, as in *Hordeum jubatum.* Generally this type of abbreviated stem, which may be classed as a short lived perennial or winter annual, sends out an abundance of fibrous roots. In case of the *Phleum pratense* the thickened base is a rudimentary corm.[13] Again, there is the type of rhizome rep-

[13]Kraemer, Henry, Botany and Pharmacognosy. p. 105. 'A corm is intermediate between a true tuber and a bulb, it is more in the nature of a thickened internode, being surrounded in some cases by thin membranous scales' as in *Allium Cepa.*

resented by *Andropogon nutans,* where the coarse buds arise from the base of the growth of the previous year and develop a bunch grass. *Sporobolus cuspidatus* sends up new shoots at every node[14] of the thickened rhizome.

RHIZOMES.

The purpose of rhizomes is to absorb nutrition from soil and air through the roots, and to propagate the plants. The shoots may be aerial or subterranean. According to Kraemer, "roots and rhizomes represent those parts of plants which develop underground, the latter having all of the characteristics of stems except in their manner of growth."[15] They may be distinguished from the roots by buds, nodes, internodes and reduced leaves in the form of scales. Rhizomes may be upright, horizontal or oblique, depending upon their manner of growth,—determined when stem scars are horizontal. This, however, is not always possible to do, in case of the rhizomes of grasses. The rhizome, root-stock, and underground stem are synonymous terms. The rhizome may be slender, each branch terminating in a single shoot as in *Poa compressa,* or producing several slender shoots as in *Poa pratensis,* or it may be scalelike with nodes very close together as in *Muhlenbergia racemosa.*

ROOTS.

The roots of the grasses are usually slender and fibrous. Most of them vary in gross structure only as to the length, thickness and number of root hairs. Thus, the roots are not a determining character.

CULM.

The culms of grasses, sometimes called stems, are either erect, decumbent or creeping. In case of the latter they are termed stolons, and root at the nodes. The culms are in most instances cylindrical as in *Agrostis alba,* but some are flattened, as in *Poa compressa.*

The sedges may be distinguished from the grasses by their three-angled stem and straplike leaves. The grasses have two ranked leaves while the sedges have three.

[14]This is true in all instances noted.

[15]Kraemer, Hon. Botany and Pharmacognosy. p. 443.

LEAVES.

"The leaf is a lateral organ of the stem, borne singly at the nodes"[16]. The two conspicuous parts of the leaf are the sheath and the blade. The sheath or leaf base enwraps the stem and opens on the side opposite the leaf and is cylindrical in form. The color of the sheath is usually light green to white at the base but in some species it is distinctly colored. The blade forms the chief foliage organ and is usually flat, sometimes depressed in the middle along the midnerve. The *ligule* is formed at the top of the sheath at the junction of the blade and sheath. The ligule is membranous, seemingly a continuation of the lining of the sheath. The ligule is a significant character in the identification of young grasses. In some cases the ligule is absent, but when present it may be classed as to form; these forms are described, according to Carrier[17] "as entire, when there are no notches or indentations along the margin, lacerates, when the margin is much cut; truncate, when the apex is apparently cut off squarely; acute, when the apex terminates in a sharp point; and ciliate, when the margin is fringed with hairs." The identification of the ligule is more difficult after the grass becomes older as the ligule becomes split and sometimes an entire ligule of a young shoot will appear ciliate when it becomes older. The collar when present is distinguished usually by a lighter colored band, or by a difference in texture at the junction of the sheath and leaf. It is scarcely distinguishable in some species, and in others it is a marked character. In some instances it is pubescent. It may be a continuous band extending across the leaf, arising at the base of the ligule and extending upward about 2 to 3 mm. In some species it is wider on either margin, in others it is completely divided into two parts by the midnerve. The auricles are membranous appendages projecting from the collar or from the top of the sheath.

The vascular system is represented in the grasses by nerves of the culm, midnerves of the leaf and nerves of the sheath which are continued in the leaf. They are very conspicuous in some species, as in *Agrostis alba,* and in others are scarcely discernible.

[16]Hitchcock, A. S., A Text Book of Grasses, p. 103.

[17]Carrier, Lyman, Identification of Grasses by Their Vegetative Characters: U. S. Dept. Agric. Bull. 461, 1917.

DESCRIPTIONS OF VEGETATIVE ORGANS

Agropyron repens. Quack Grass or Couch Grass. Figure 121. Pale green glaucous perennial, or sometimes a bright green, but lacking the bluish green color of *Agropyron Smithii.* This species had no resisting period when transferred to the greenhouse or to the laboratory. Often only one culm grows from a node. The rhizomes are vigorous, creeping, especially radiating from the

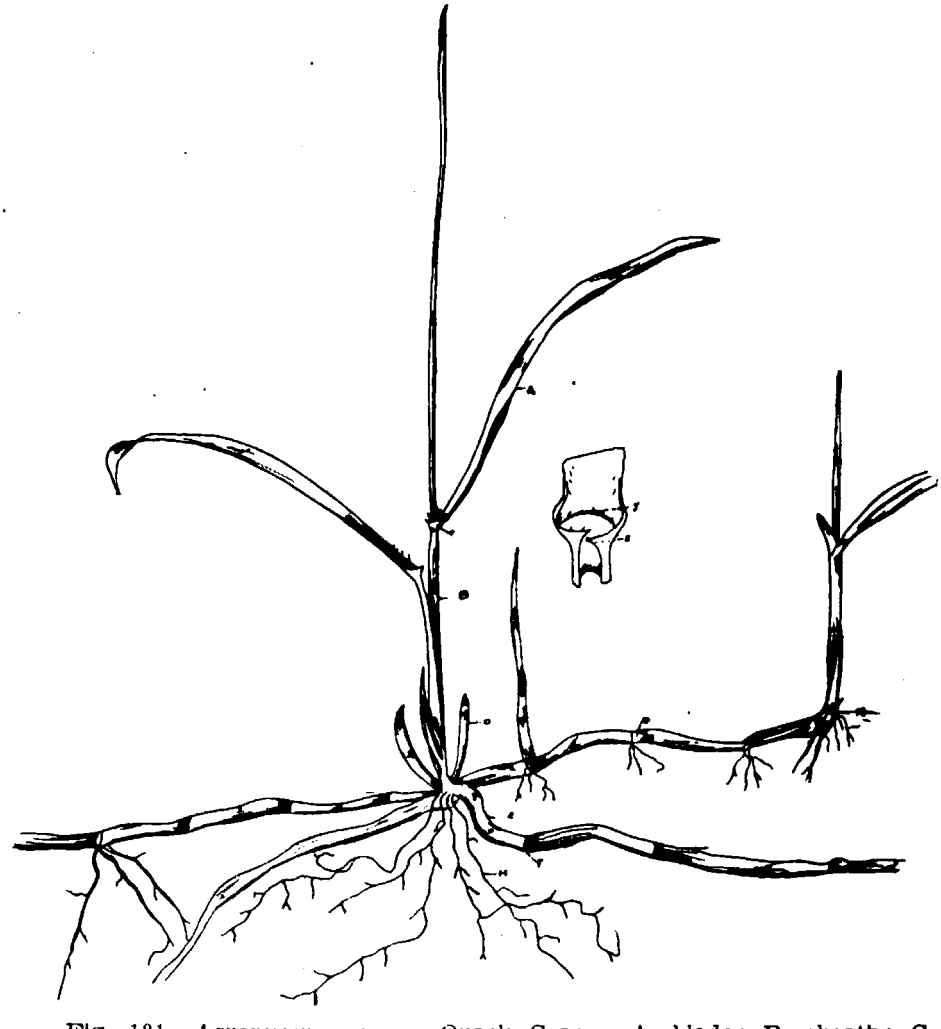

Fig. 121—*Agropyron repens.* Quack Grass. A, blade; B, sheath; C, collar; D, bud; E, old rhizome; F, node; G, scale; H, roots; I, auricle; J, ligule; K, terminal node and shoot.

terminal node of the last year's growth, or from the base of the old culms. The rhizomes are coarse, averaging one-third cm. in diameter. Scales are hairy and conspicuous, in some specimens reaching from one node to the other; nodes are one to one and a half cm. apart; buds arise at the nodes, the terminal node although a new shoot makes its appearance.

Roots do not originate at every node. Roots are few, short and fibrous. Leaves rolled in the bud; ligule membranous, short, entire; sheath open, not compressed; blade flat, sharp-pointed, one-half cm. wide; nerves inconspicuous, broad, pubescent just above the ligule, especially on either side of the mid-nerve. Collar broad, narrow pubescent. Auricles present, slender, terminating in a hairlike appendage.

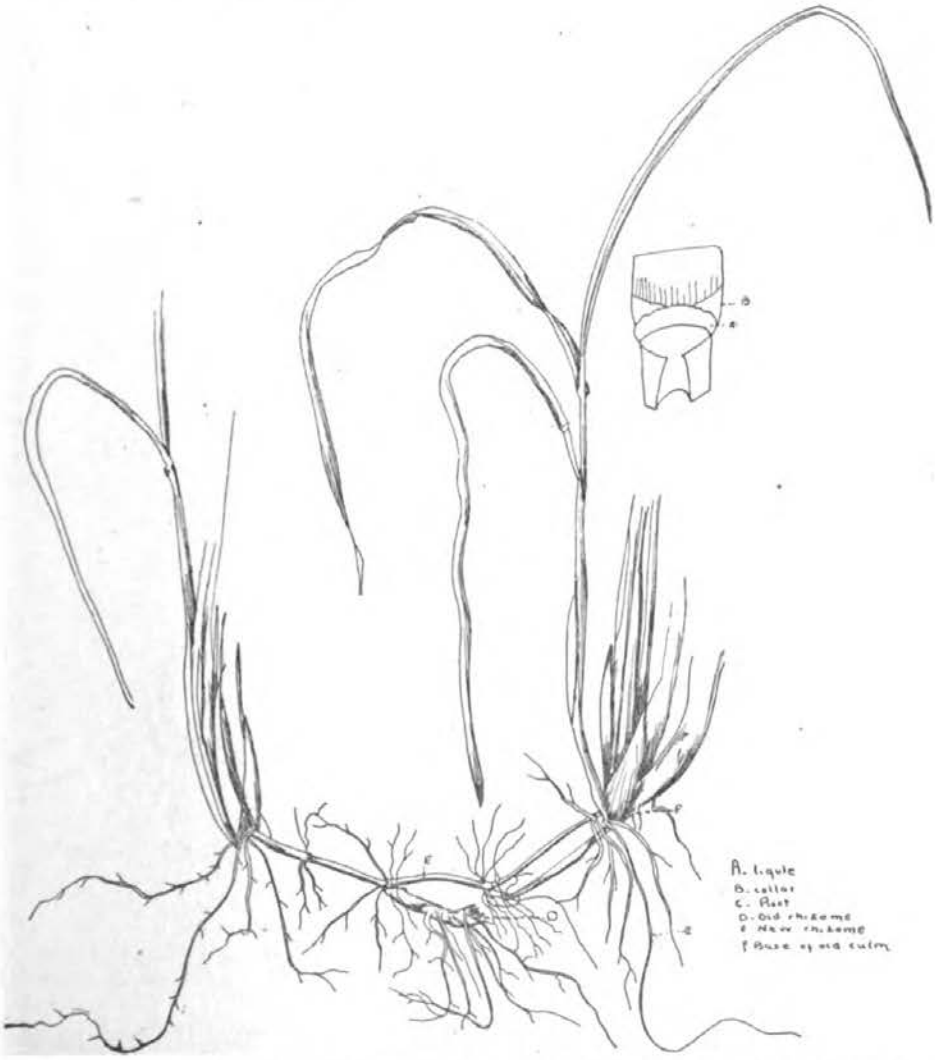

Fig. 122—*Agropyron Smithii.* Western Wheat Grass. A, ligule; B, collar; C, leaf rolled in bud; D, new rhizome; E, rhizome of previous year's growth.

Agropyron Smithii. Western Wheat Grass. Figures 122 and 123.

An upright, glaucous, bluish green perennial. Several culms in a cluster. Rhizomes creeping, slender, one to two mm. wide. Nodes [illegible] apart. The old rhizome dies, and from

the node where a new rhizome arises there is an enlarged node and many roots. The scales on a young rhizome extend from one node to another and are not conspicuous until the rhizome becomes older, except that they are brown in color while the young rhizome itself is yellowish white. Extending from the rhizome is an abundance of very long, tough roots. Many more roots are found on this species than on *Agropyron repens*. New buds do

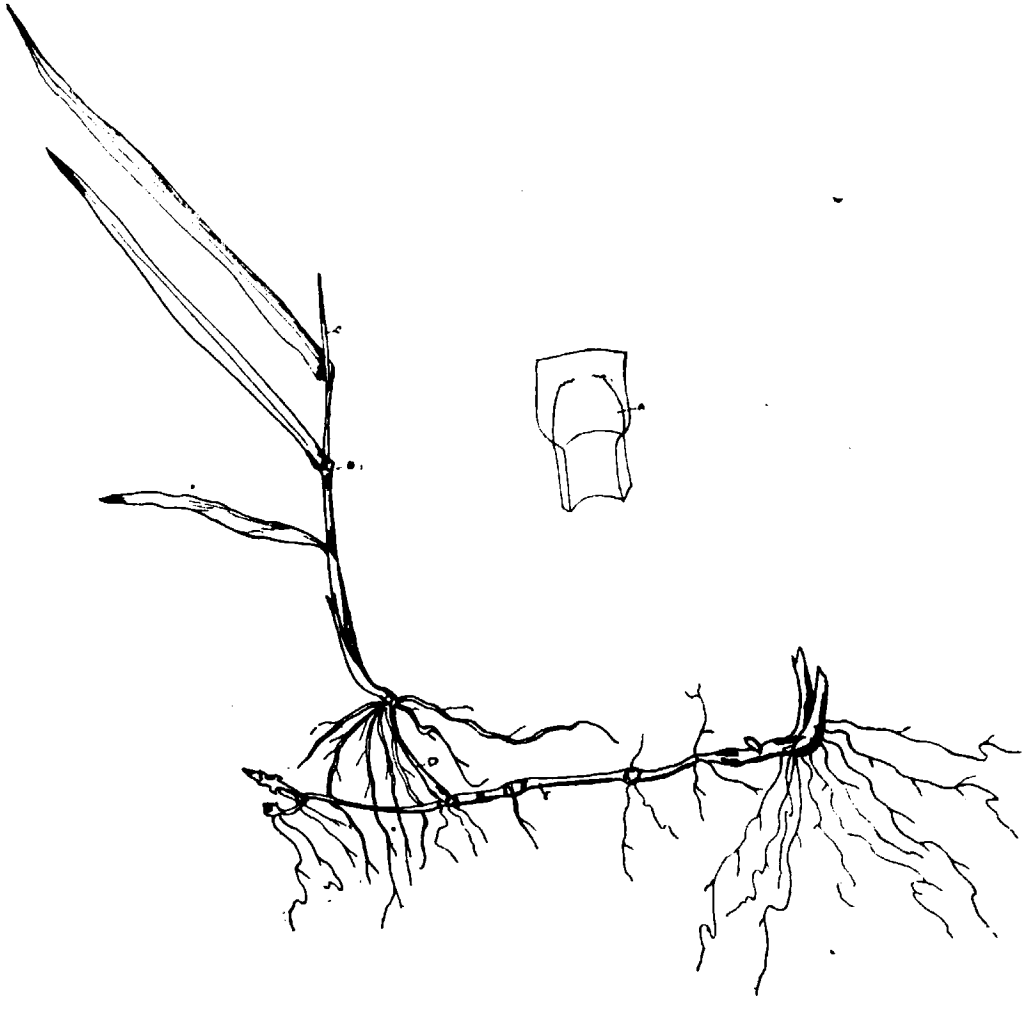

Fig. 123—*Agropyron Smithii*. Western Wheat Grass.

not always grow from terminal nodes of old root stock. Leaves rolled in the bud, sheaths tightly compressed in the young shoot. In older shoots, it leans away from stem. Blades two and one-half to five mm. wide, comparatively long and flat. Ligule finely toothed, narrow membranous; collar light, inconspicuous in young shoots but becoming green to white, widened at the margins in older plants. Nerves in blade, conspicious. Auricles absent.

Agropyron tenerum. Slender Wheat Grass. Figure 124.

An erect, smooth, soft leaved perennial, growing in bunches or tufts. Resting period two to three weeks. Rhizomes not creeping but forming a short, tough, thickened rootstock at the base of the previous year's growth. From this grow a number of culms, hence its descriptive term "bunch" grass. The nodes, scarcely distinguishable, are very close together and from them develop an abundance of long, tough, fibrous roots, having

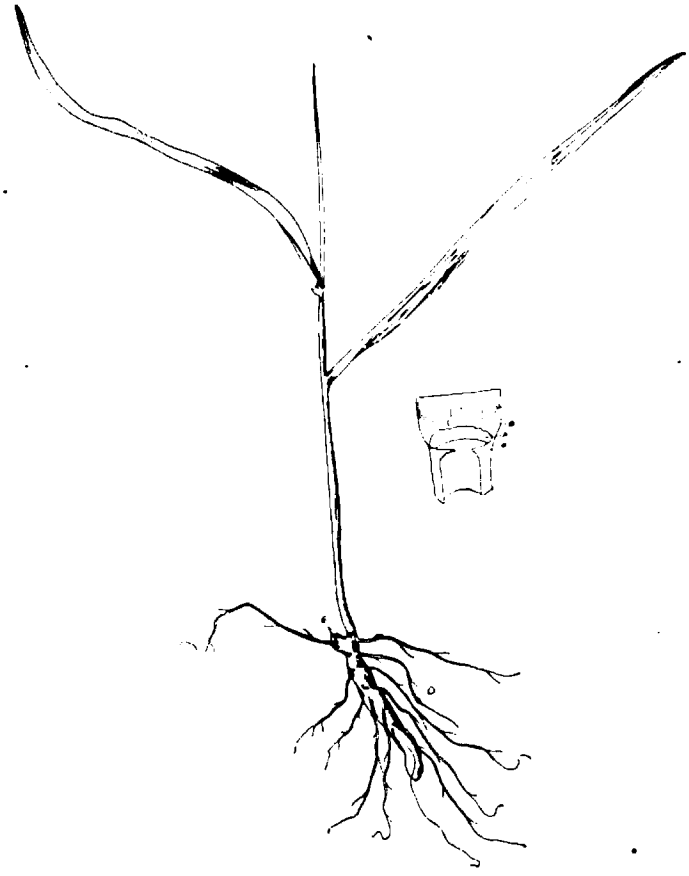

Fig. 124.—*Agropyron tenerum.* Slender Wheat Grass. A, ligule; B, collar; C, auricles; D, rhizome; E, last year's growth.

many root hairs, the scales not conspicuous if present. The leaves are rolled in the bud, glaucous, three to six inches long, narrow, rather rigid and flat. Ligule membranous, short obtuse, slightly wavy along the upper edge. Sheathes compressed. Auricles present, conspicuous, pointed or clawlike. Blade narrow, glaucous, flat, sharply pointed, one and one-half to three mm. wide. Nerves rather prominent. Collar broadened at margin, narrow at the mid-nerve.

Agrostis alba. Red Top. Figure 125.

A perennial; the bases of the culms are decumbent. Rhizomes slender, one-sixteenth inch in diameter, scales formed at nodes: long fibrous roots found at every node. New shoots sent up from terminal bud of old rhizome followed by buds at intermediate nodes. Roots are numerous at base of a shoot, and a lesser number found at the nodes. Roots fibrous, slender. Leaves rolled in the bud, dark green, glabrous, linear. Blade, flat linear, sharply pointed, one-fourth to one-half cm. wide, somewhat rough on margin and surface, thin, coarsely nerved. Sheaths smooth.

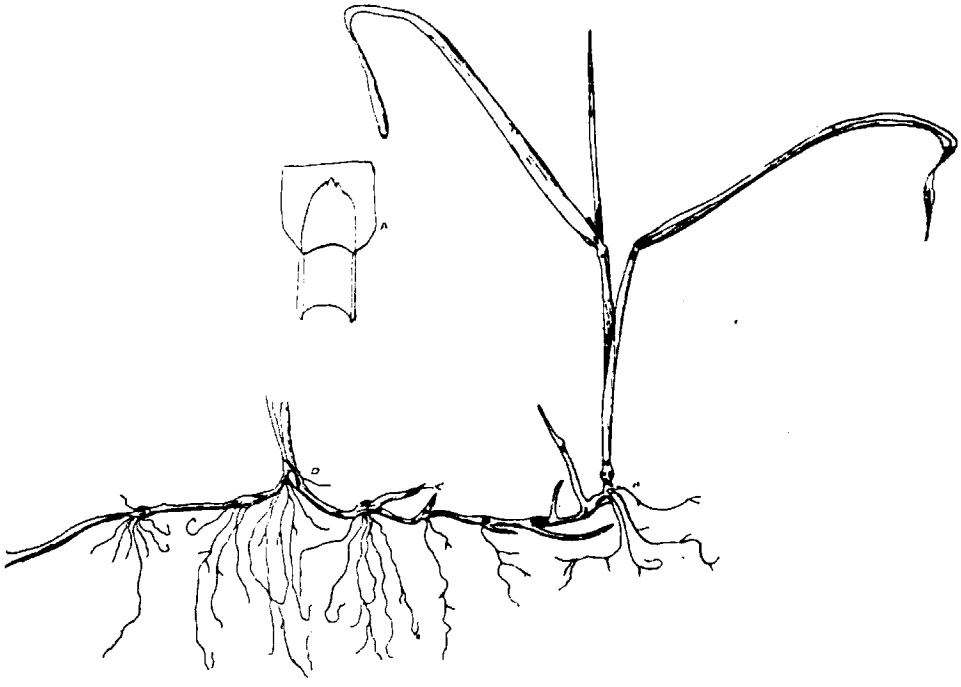

Fig. 125.—*Agrostis alba.* Red Top. A, ligule; B, terminal node and shoot; C, bud at node of rhizome; D, base of old culm.

not compressed, about the same length as the internodes. Ligule acute, long, toothed, membranous, thin, white. Collar rather narrow, divided into two distinct parts by a glabrous portion of the blade. Auricles not present.

Andropogon furcatus. Blue Stem. Figure 126.

An upright perennial. The resting period was from November to January. Rhizomes slender, woody, tough, clustered; nodes enlarged, conspicuous scales enwrap the internodes. New rhizomes appear first from the base of the old cluster. The new shoots make their first appearance from the base of the old culms followed by those from the terminal bud which does not

develop intermediate buds on the rhizome at the nodes. Roots are tough, long and very fibrous. Leaves dark green, folded in the bud. Blade broadened at collar, flat, margin slightly scabrous, nerves conspicuous. Sheath smooth, white to light green

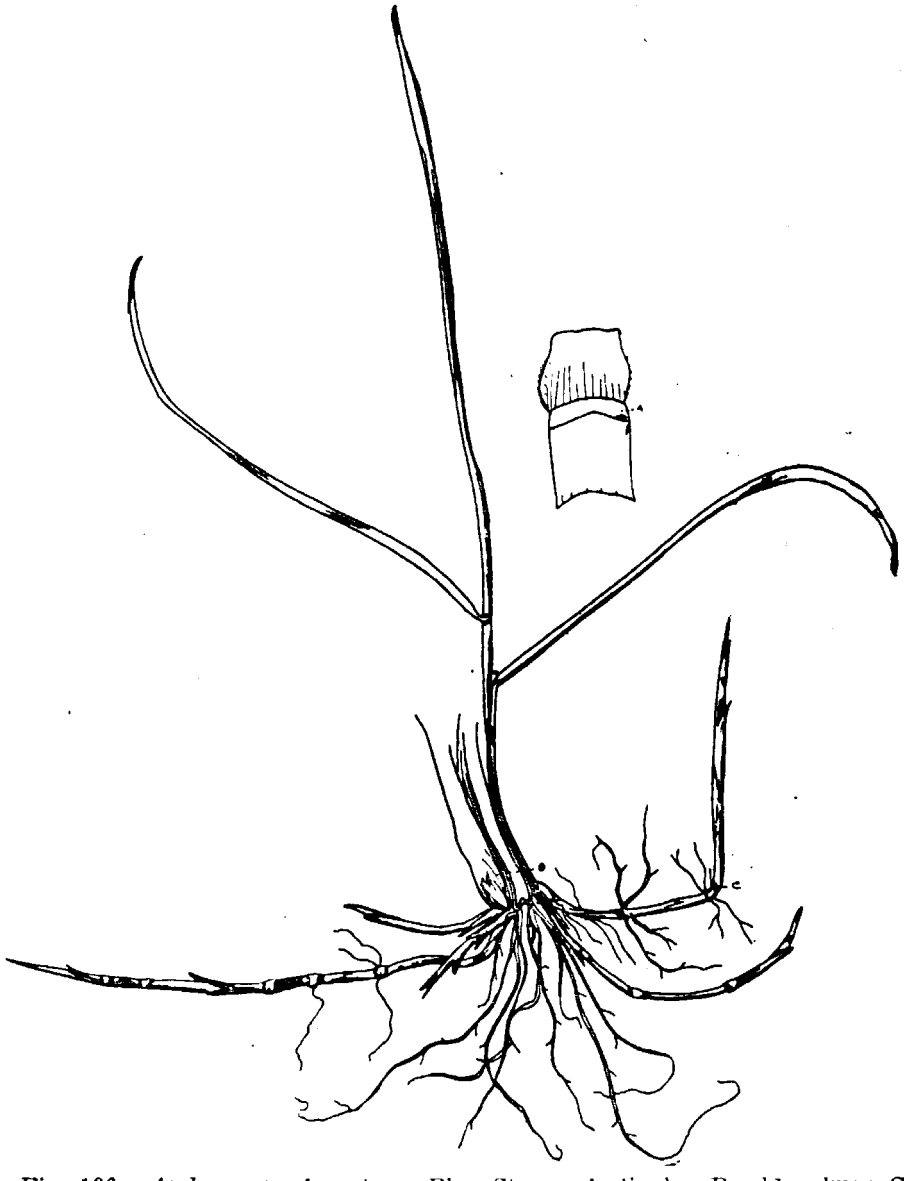

Fig. 126.—*Andropogon furcatus.* Blue Stem. A, ligule; B, old culms; C, terminal node from new rhizome.

at base. Ligule slightly pointed in middle when blade is folded, membranous, short, continuous. Collar light green, becoming very conspicuous in older plants. Margin of collar slightly hairy.

Andropogon nutans. Indian Grass. Figure 127.

A stout perennial, having a long rest period. At the base

of the old culm, the rhizomes resemble a group of thickened buds with coarse scales entirely covering them. The new shoots arise in a cluster about the base of the dead culm, the nodes of the rhizome being marked by a new series of scales. From the cluster of new shoots a branch rhizome may be sent out leading to another cluster. Long,

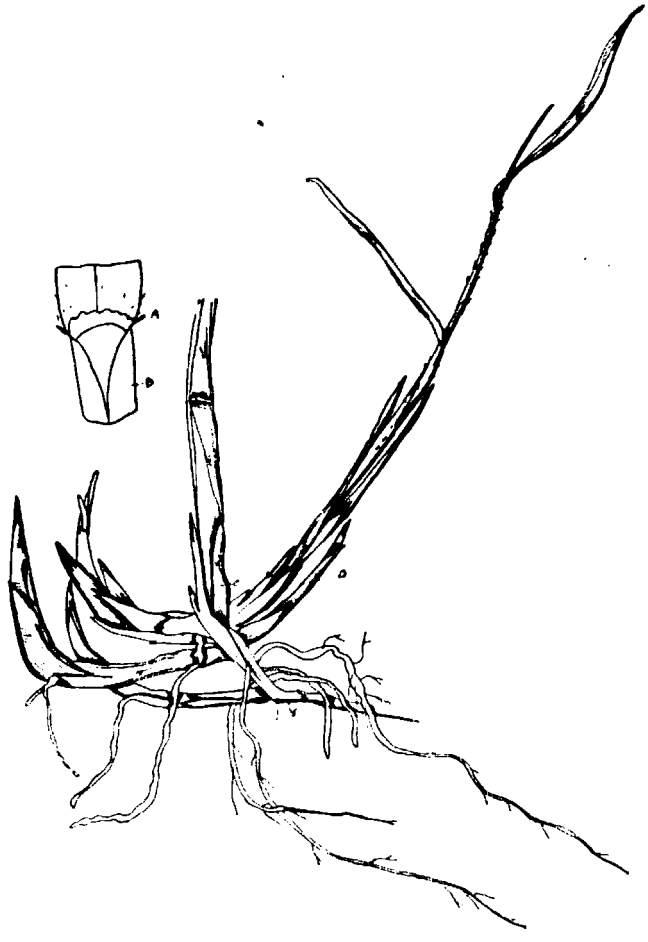

Fig. 127.—*Andropogon nutans.* Indian Grass. A, ligule; B, sheath; C, old culm; D, new shoot and bud; E, old rhizome.

coarse roots are sent out from the base of the old culm and nodes of the rhizome. Leaves, dull green, folded in bud. Blades flat, pubescent, compressed at base. Sheath compressed, pubescent. Ligule narrow, membranous, toothed, truncate. Auricles present in form of hairlike appendages, not distinct.

Andropogon scoparius. Little Blue Stem. Figure 128.

Upright perennial. Rhizomes slender, sending out many new shoots from the base of the old culm, also one or two new

rhizomes. Internodes short, scales at node short, fringed. Nodes on a new rhizome conspicuous. The old rhizome dies. Roots few, fibrous. Leaf folded in bud, dull green. Sheaths not compressed. Blades flat, compressed at base, one to two and one-half cm. wide. Ligule narrow, membranous, acute.

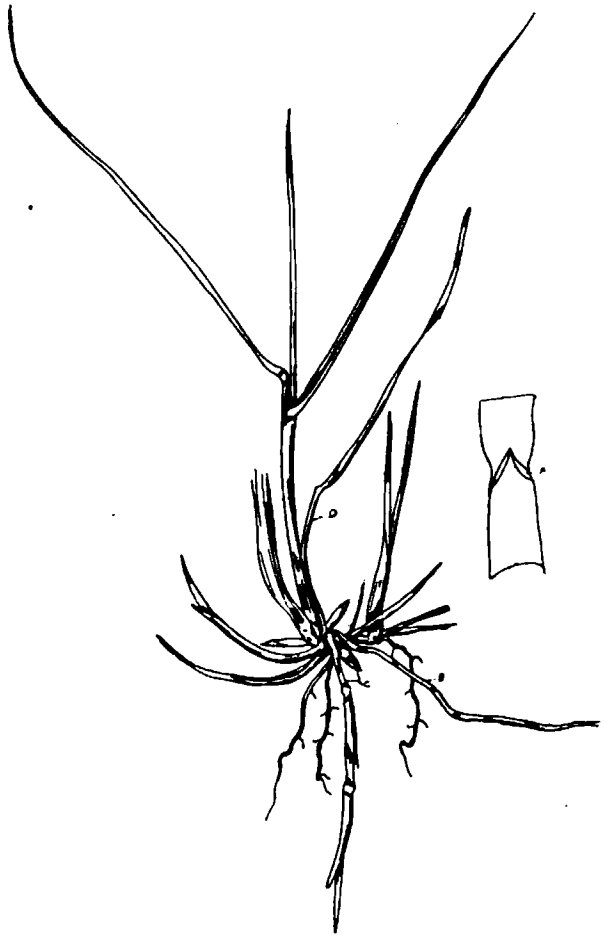

Fig. 128.—*Andropogon scoparius.* Little Blue Stem. A, ligule; B, old rhizome; C, new rhizome and bud; D, sheath.

Bouteloua curtipendula. Tall Grama Oats. Figure 129.

Tufted perennial. New buds did not arise from base of old culm but rather from terminal bud of rhizome, followed by a group of short rhizomes sending up shoots from terminal bud. Rhizome thick, tough. Roots from nodes, long, slender, many short root hairs. Leaves rolled from both sides toward middle. Sheaths loose, not compressed, sometimes sparsely pubescent, leaning away from bud. Collar not differentiated. Blades, scabrous, three to four mm. wide.

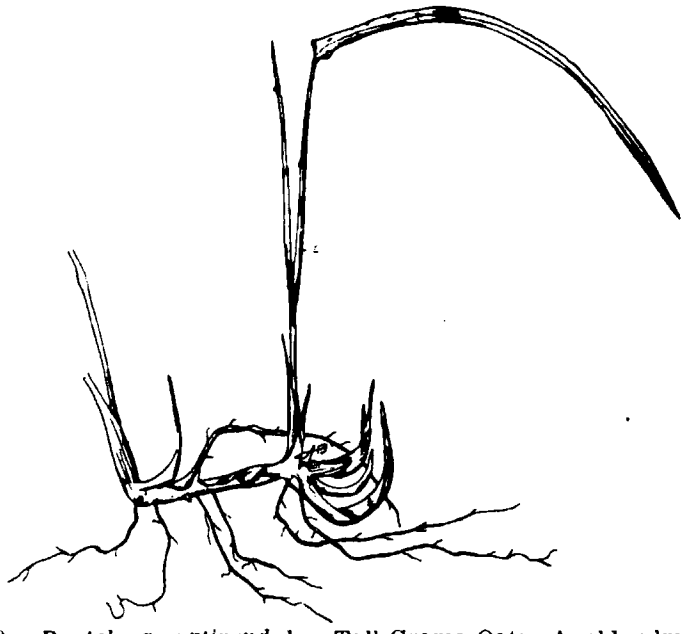

Fig. 129.—*Boutcloua curtipendula.* Tall Grama Oats. A, old culm; B, terminal shoot and buds; C, sheath.

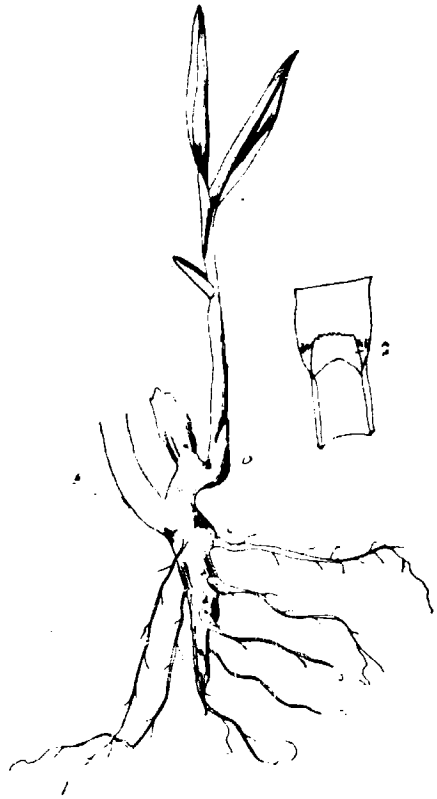

Fig. 130.—*Dactylis glomerata.* Orchard Grass. A, ligule; B, collar; C, rhizome; D, base of new shoot; E, old culm.

Dactylis glomerata. Orchard Grass. Figure 130.

A coarse, light green, tufted perennial. Rhizomes, short, thick, nodes scarcely distinguishable, the new shoot growing from the old rhizome, followed by a number of shoots, forming a tuft, culms somewhat decumbent at base. Roots long, coarse, having many root hairs. Leaves when young conduplicate, long, keeled,

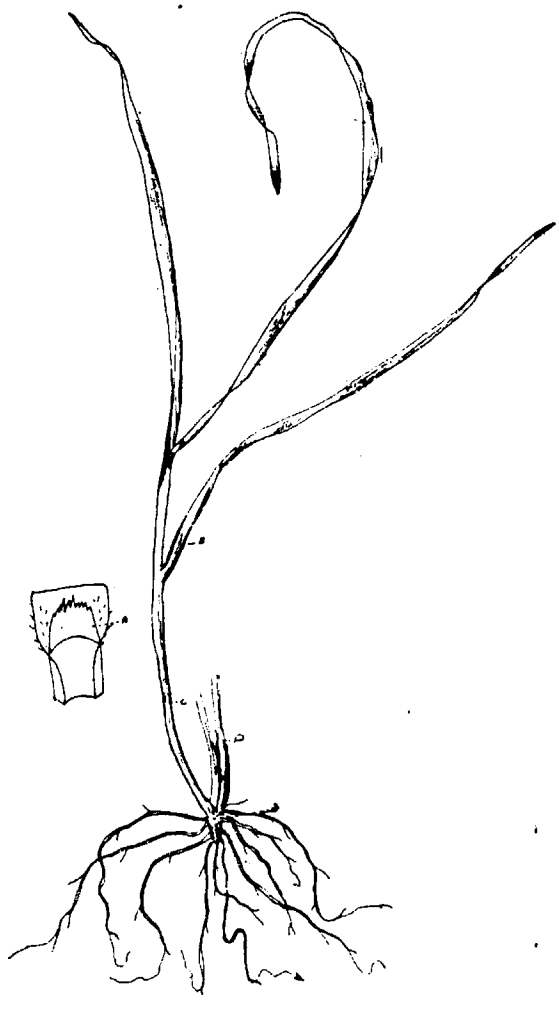

Fig. 131. *Hordeum jubatum.* Squirrel Tail. A, ligule; B, rudimentary corm; C, sheath; D, old culm; E, blade.

folded in bud along midnerve. Blade one-fourth inch or more wide, scabrous, flat, keeled, broad, soft in texture, drooping, sharp-pointed; culms erect, smooth; young shoots flat, keeled. Sheaths compressed, white at base, somewhat scabrous. Ligule elongated, toothed, membranous, lacerate. Auricles wanting. Collar light yellow, broad, conspicuous.

Hordeum jubatum. Squirrel Tail. Figure 131.

Slender, erect winter annual. This species does not have a creeping rootstock, but a short, somewhat thickened rhizome, shoots producing a tufted grass. An abundance of long fibrous roots are produced. Leaves smooth, rolled in bud; blade flat, long, linear, pointed, pubescent. Sheath compressed, pubescent. Ligule acute, toothed. Collar wanting.

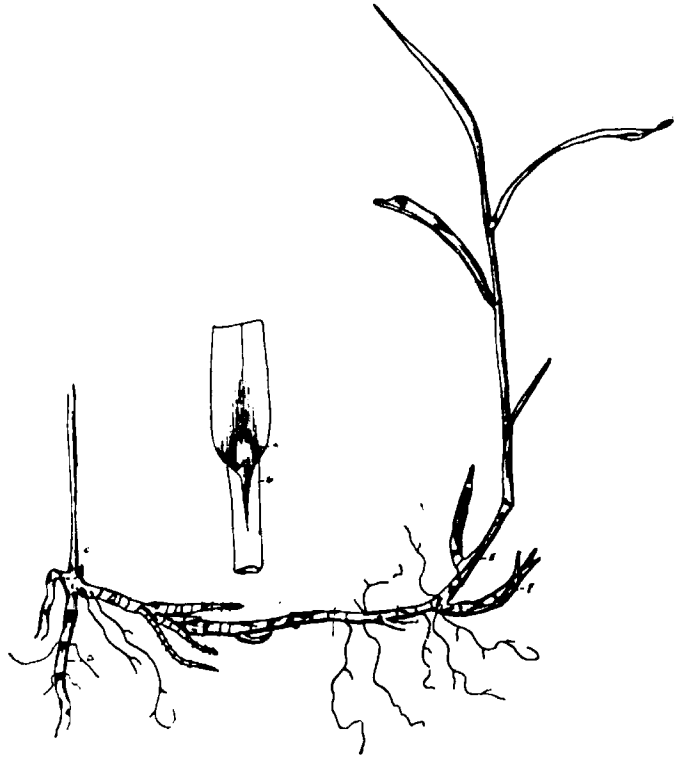

Fig. 132.—*Muhlenbergia Mexicana.* Mexican Drop Seed. A, ligule; B, sheath; C, old culm; D, old rhizome; E, new rhizome with terminal shoot; F, buds from new rhizome.

Muhlenbergia Mexicana. Mexican Drop Seed. Figures 132 and 133.

A decumbent, slender, glabrous perennial. Resting period from October until March. Rhizome, rather slender, creeping, many new rhizomes branching from the nodes. New culms do not always appear the following year at the base of the previous year's growth. First new shoot appears at terminal bud or end of rhizome, followed by several more from the same base. Rhizomes very scaly, nodes one-half to one and one-half cm. apart. Roots very delicate, fibrous. Leaves, rolled in bud. Blades one-third to one-half cm. wide, thin, flat, pale green. Sheaths com-

pressed, loose. Culms slender, short joints. Ligule acute, lacerate, membranous. Collar broadened on either margin. Auricles wanting.

Fig. 133.—*Muhlenbergia Mexicana.* Mexican Drop Seed.

Muhlenbergia racemosa (*glomerata*). Marsh Muhlenbergia. Figure 134.

A wiry perennial. Resting period from October to March. Rhizome thickened, much more so than in *Muhlenbergia Mexicana*, not as scaly. From the rhizome of the previous year's growth is sent up a new shoot, much branched, although not as much so as *Muhlenbergia Mexicana*. New rhizomes are sent out from the base of old culms. These rhizomes are markedly scaly. Roots are long, slender. Leaves rolled in bud, having the appearance of a series of many scales when young. Blade flat,

scabrous, pointed, narrow and numerous; sheaths long; ligule narrow, lacerate; collar widening at either margin; auricle wanting.

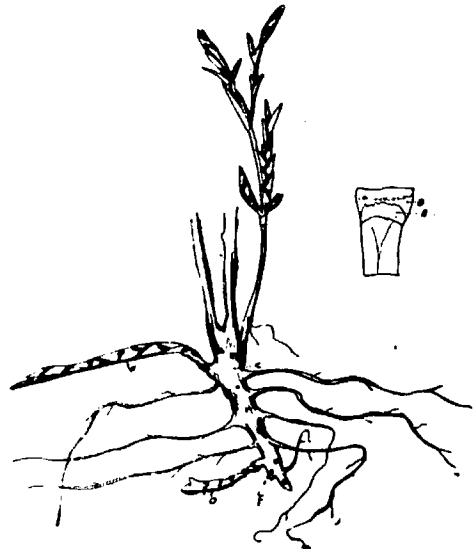

Fig. 134.—*Muhlenbergia racemosa.* Marsh Muhlenbergia. A, ligule; B, collar; C, base of dead culm, and base of new shoot; D, dead culm of previous year's growth; E, new rhizome; F, rhizome scars.

Panicum Scribnerianum. Scribner's panicum. Figure 135.

A very erect perennial with a slender, very vigorous, creeping, almost white rhizome. The nodes are not conspicuous. New shoots arise in somewhat uniform growth from buds at the nodes but first appear at extremes of growth. Roots are long, rather tough, but not especially numerous. Leaves rolled in bud, blade flat, slightly scabrous, one-half to three-fourths cm. wide, sharp, pointed, glabrous. Sheath loose, striate, sometimes slightly pubescent. Ligule acute, slightly toothed. Auricles wanting. Collar broadened at margins, narrowed in middle.

Panicum virgatum. Switch Grass. Figure 136.

An erect perennial. Rhizome creeping, very tough, one-eighth to one fourth inch in diameter, scales conspicuous. The new shoots do not come from the terminal end of the old rhizome. New shoots may spring from base of old culms; new buds arising from nodes of rhizome are twisted, growing obliquely until they reach the surface of the ground. Roots few but long and coarse. Leaves glabrous, rolled in the bud, which is cylindrical. Sheaths ciliate along margin at the top, smooth, not compressed. Blade flat, narrowed at the base, one-eighth to one-half inch

wide, pointed, glabrous, slightly scabrous. Ligule ciliate, dense, two to three mm. long, Collar hairy, auricles wanting.

Poa compressa. Canada Blue Grass. Figure 137.

A bluish green perennial. Resting period twenty-four days. Rhizomes creeping, slender, one sixteenth to one eighth inch in

Fig. 135.—*Panicum Scribnerianum.* Scribner's Panicum. A, ligule; B, sheath; C, shoot at node; D, terminal node and first shoot; E, rhizome.

diameter. One shoot from each branch; new shoots appear from bud at node of old rhizome which later dies. Roots fibrous and very slender but stout. Leaves folded in bud. Blades flat, long, linear, pointed, pale green, glaucous, double lines along midnerve by transmitted light. Sheath tinged with red at base. compressed, smooth. Ligule membranous, entire, acute, medium long. Collar very light green. Auricles wanting.

Poa pratensis. Kentucky Blue Grass. Figures 138 and 139.

A dark green erect perennial. Resting period same as *Poa compressa.* Rhizome extensively creeping, averaging two mm. in diameter, slender, having more conspicuous scales and nodes than *Poa compressa.* New shoots are produced from the ends of the rhizome only. Roots slender, fibrous, hairlike. Leaves in new shoot forming distinct sheath, dark green, glabrous. Blades two and one-half to four mm. wide, smooth, linear, compressed at base, pointed at tip, flat. Sheath, smooth, compressed,

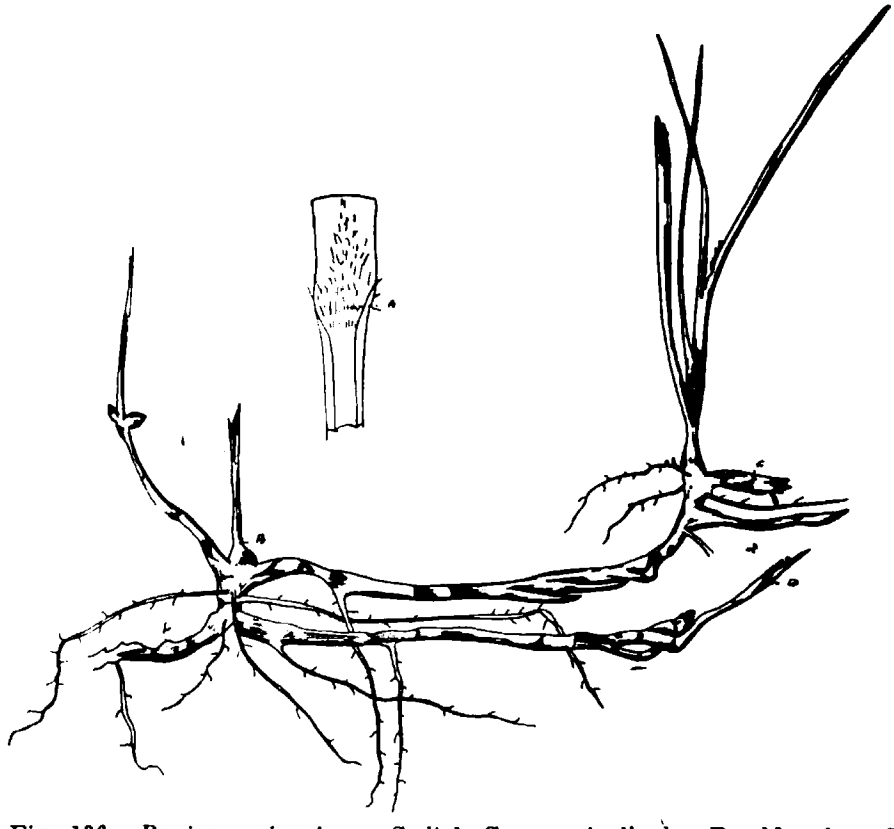

Fig. 136.—*Panicum virgatum.* Switch Grass. A, ligule; B, old culm; C, old rhizome; D, bud.

white at base. Collar light green. Ligule narrow, entire, membranous, truncate; auricles wanting.

Spartina cynosuroides. Slough Grass. Figure 140.

A stout, erect perennial. Rhizome brown, very thick, creeping, woody. Nodes at regular intervals, scales dark; roots coarse, having fine root hairs. Growth of new shoot takes place from base of old culm; rhizome at this point is very thick where the scales are somewhat twisted. Leaves rolled in the bud. Blades

coarse, scabrous, four to eight mm. wide, glaucous. Sheaths compressed, coarsely nerved. Brown scales are numerous, coming from the base of the culms. Ligule ciliate, forming a fringe of hairs. Collar light green to yellow, conspicuous on the inside.

Sporobolus cuspidatus. Prairie Rush Grass. Figure 141.

Long resting period. Rhizome creeping. Buds appear at almost every node, also an abundance of very long, coarse, fibrous roots. Nodes conspicuous.

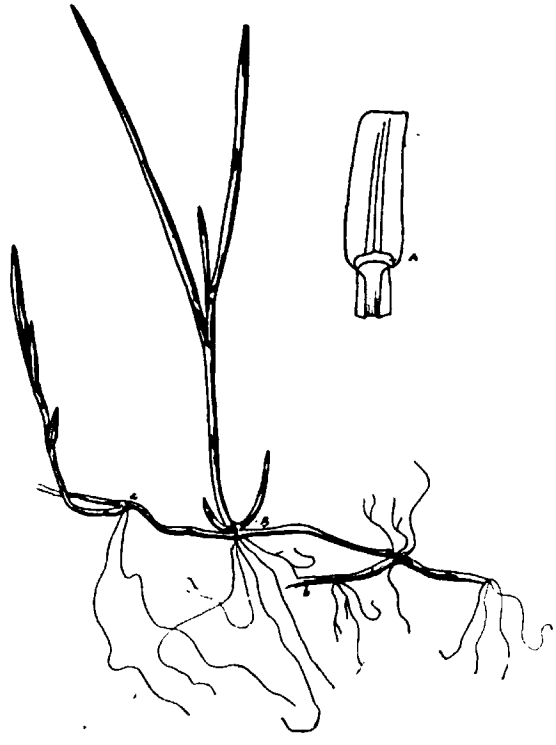

Fig. 137.—*Poa compressa.* Canada Blue Grass. A, ligule; B, first shoot and buds at node of old rhizome; C, node; D, old rhizome.

Sporobolus longifolius. Long Leaved Rush Grass. Figure 142.

Buds of rhizome arise in clusters.

Stipa spartea. Porcupine Grass. Figure 143.

An erect perennial. Resting period four months. Rhizomes creeping, the branching rootstocks of the main basal rhizome die the following year, while new rhizomes grow out and their terminal buds send up new shoots. The new rhizome extends in one direction only. The most vigorous growth takes place at the base of the old rhizome. Roots arising at nodes are rather short, stout, with many root hairs. Leaves folded in bud. Blades

dull, dark green, nerves prominent, one and one-half to two mm. broad, sharp pointed. Sheath somewhat lighter green than blade, entirely enclosing bud, whitish to pale green near the ground. Ligule narrow, indented at mid-nerve, membranous, collar same color as sheath; auricles wanting.

Carex. Sedge. Figure 144.

Rhizome thicker than in the grasses; scales thick, coarse; buds very short; ligule narrow, entire.

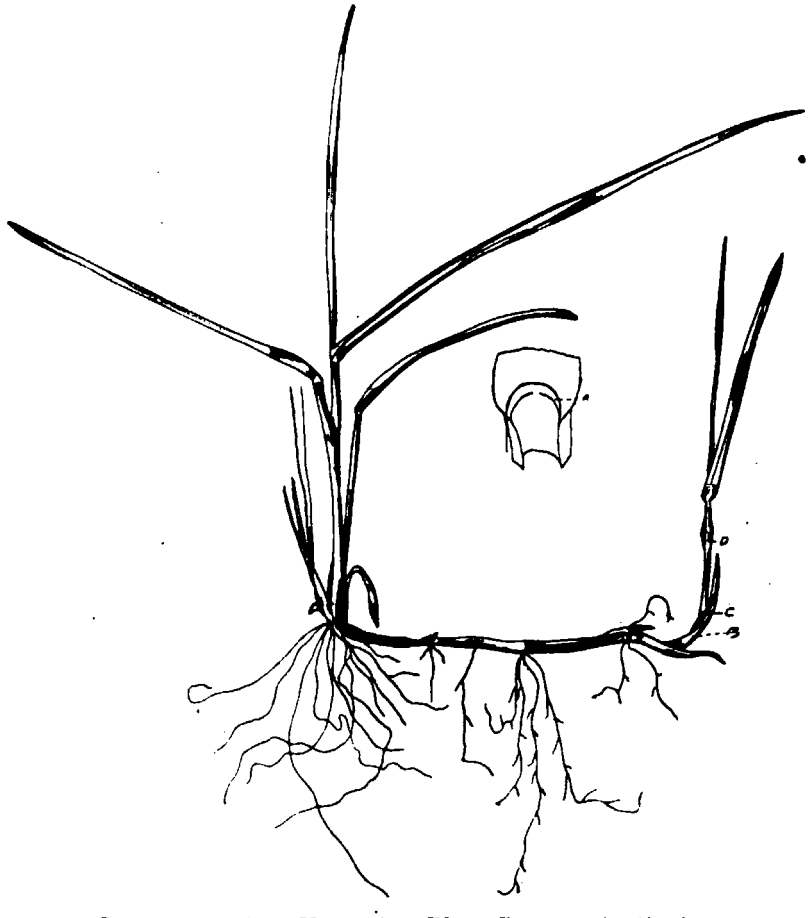

Fig. 138.–*Poa pratensis.* Kentucky Blue Grass. A, ligule; B, terminal shoot; C, scales; D, sheath.

SUMMARY.

1. Study was made of the vegetative organs of some perennial grasses which were grown in the greenhouse from October until May. Resting periods were variable.

2. *Sporobolus longifolius, Muhlenbergia Mexicana, M. racemosa, Spartina cynosuroides, Stipa spartea* had resting periods

of four months, while that of *Poa compressa* and *Poa pratensis* was two weeks.

3. A perennial grass is distinguished from an annual by the presence of a rhizome.

4. Rhizomes may be distinguished from roots by the presence of buds, nodes, internodes, and scales.

5. Rhizomes may be slender, terminating in a single shoot, or producing several shoots. They may be creeping rhizomes or rudimentary corms. In case of *Stipa spartea* the old rhizome

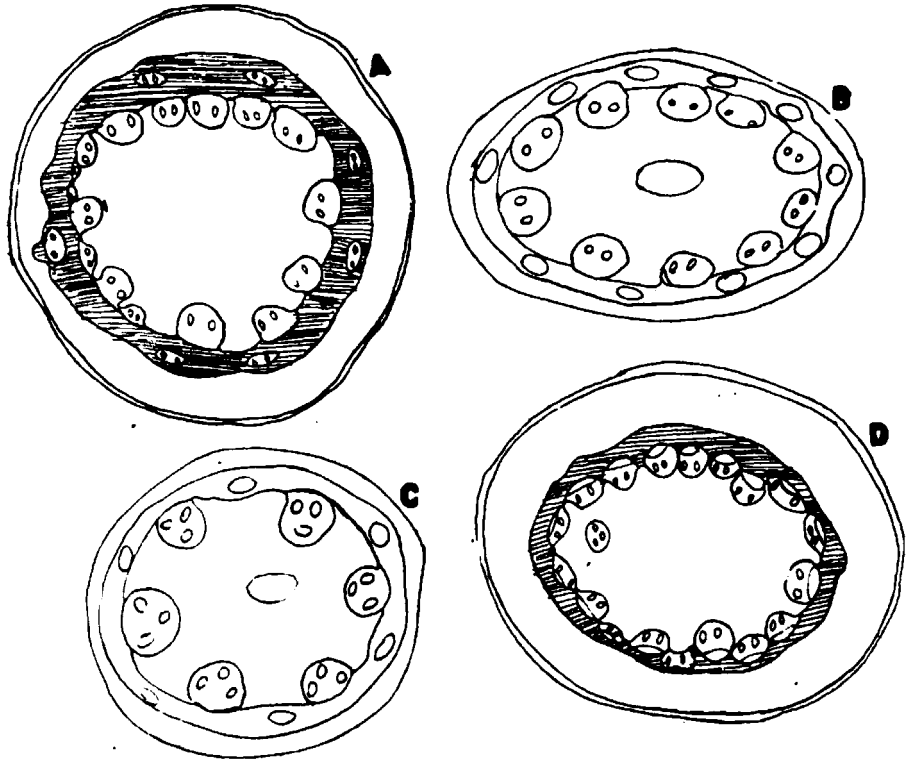

Fig. 139.—A, cross section of rhizome, *Poa compressa;* B, outline cross section of culm, *Poa compressa;* C, outline cross section of culm, *Poa pratensis;* D, cross section of rhizome, *Poa pratensis.*

dies, while the base of the old culm develops new shoots and subsequently new rhizomes which are comparatively short.

6. The roots of grasses are slender and fibrous, and vary in the same species as to gross structure; thus this is not a determining characteristic.

7. The culms of grasses are erect, decumbent or creeping, cylindrical or flattened.

8. The leaf is composed of the sheath and blade; the ligule is formed at the junction of the blade and sheath; the collar is

usually distinguished at the junction of the leaf and sheath by the color; the auricles are appendages projecting from the collar or top of sheath. These together with the rhizomes form very important basic characters for identification of grasses.

9. The vascular system is represented by nerves, in some species conspicuous. The arrangement and number of nerves is a character which aids in identification.

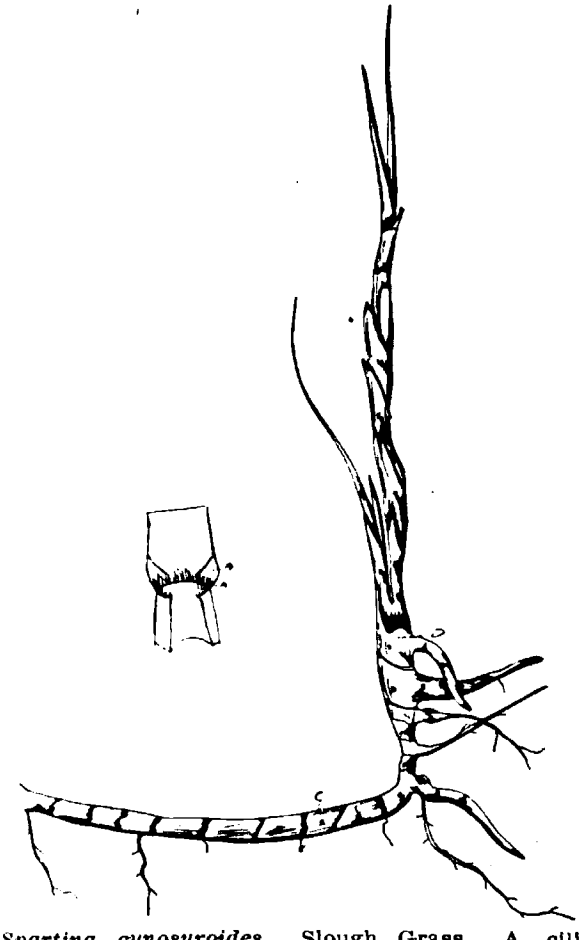

Fig. 140.—*Spartina cynosuroides*. Slough Grass. A, ciliate ligule; B, collar; C, rhizome; D, base of old culms, and new shoots and scales; E, node and scales of rhizome.

10. The character of the rhizome, blades in the bud, sheath, ligule, collar, and auricles may furnish a basis for further study of the identification of perennial grasses by their vegetative organs.

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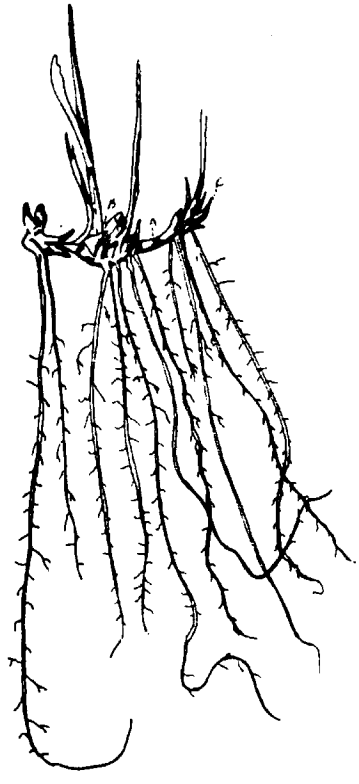

Fig. 141.—*Sporobolus cuspidatus.* Prairie Rush Grass. A, rhizome; B, base of old culm; C, new buds.

Fig. 142.—*Sporobolus longifolius.* Long Leaved Rush Grass. A, Base of old culm and rhizome; B, new buds.

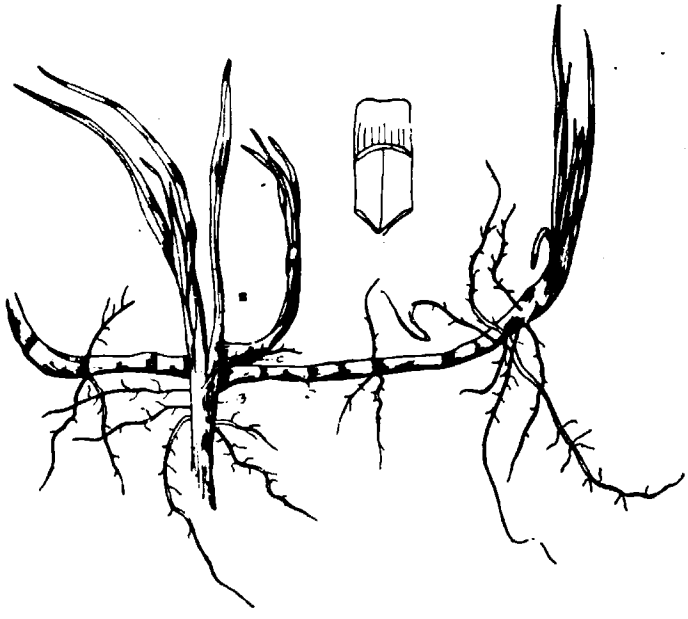

Fig. 143.—*Stipa spartea*. Porcupine Grass. A, scar of old rhizome; B, dead rhizome of previous year's growth; C, ligule; D, sheath; E, main stock of rhizome; F, new rhizome; G, terminal buds of new rhizome; H, sheath; I, sheath clasping stem.

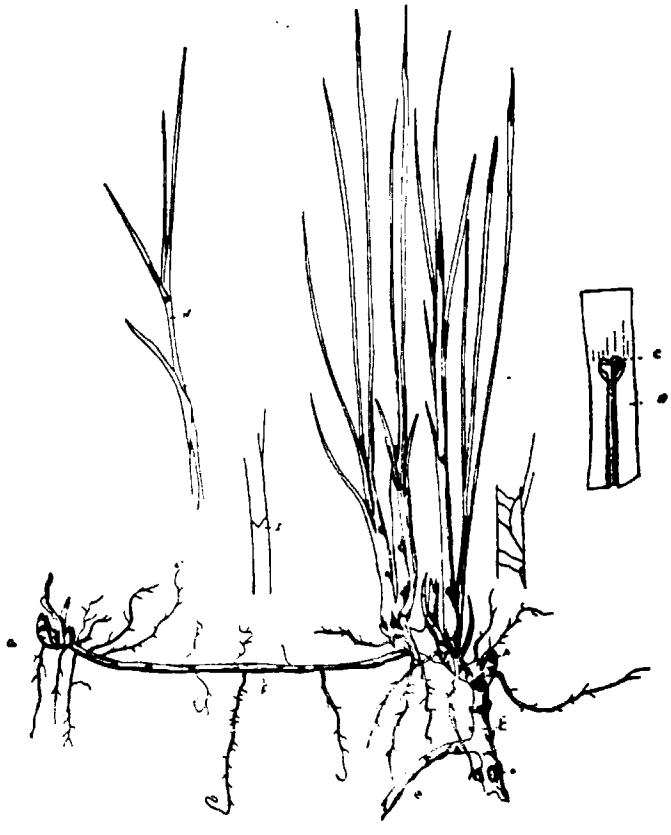

Fig. 144.—*Carex*. Sedge. A, ligule; B, old rhizome and base of new shoot; C, new shoots; D, node and scales; E, leaf.

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